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Kerr

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(54) **REMOVABLE LEAD SCREW ASSEMBLY FOR AN IMAGE PROCESSING APPARATUS**

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(22) Filed: **May 18, 1999**

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(52) **U.S. Cl.** .... **347/242**; 347/245; 346/139 D
(58) **Field of Search** .... 347/242, 245, 347/197; 400/120; 346/139 R, 139 D

(56) **References Cited**

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Re. 28,900		7/1976	Byers et al. .	
3,945,753		3/1976	Byers et al. .	
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4,628,171		12/1986	Colby et al. .	
5,268,708		12/1993	Harshbarger et al. .	
5,771,059		6/1998	Kerr et al. .	
5,829,889	*	11/1998	Kerr et al.	384/446
6,033,138	*	3/2000	Kerr	400/328

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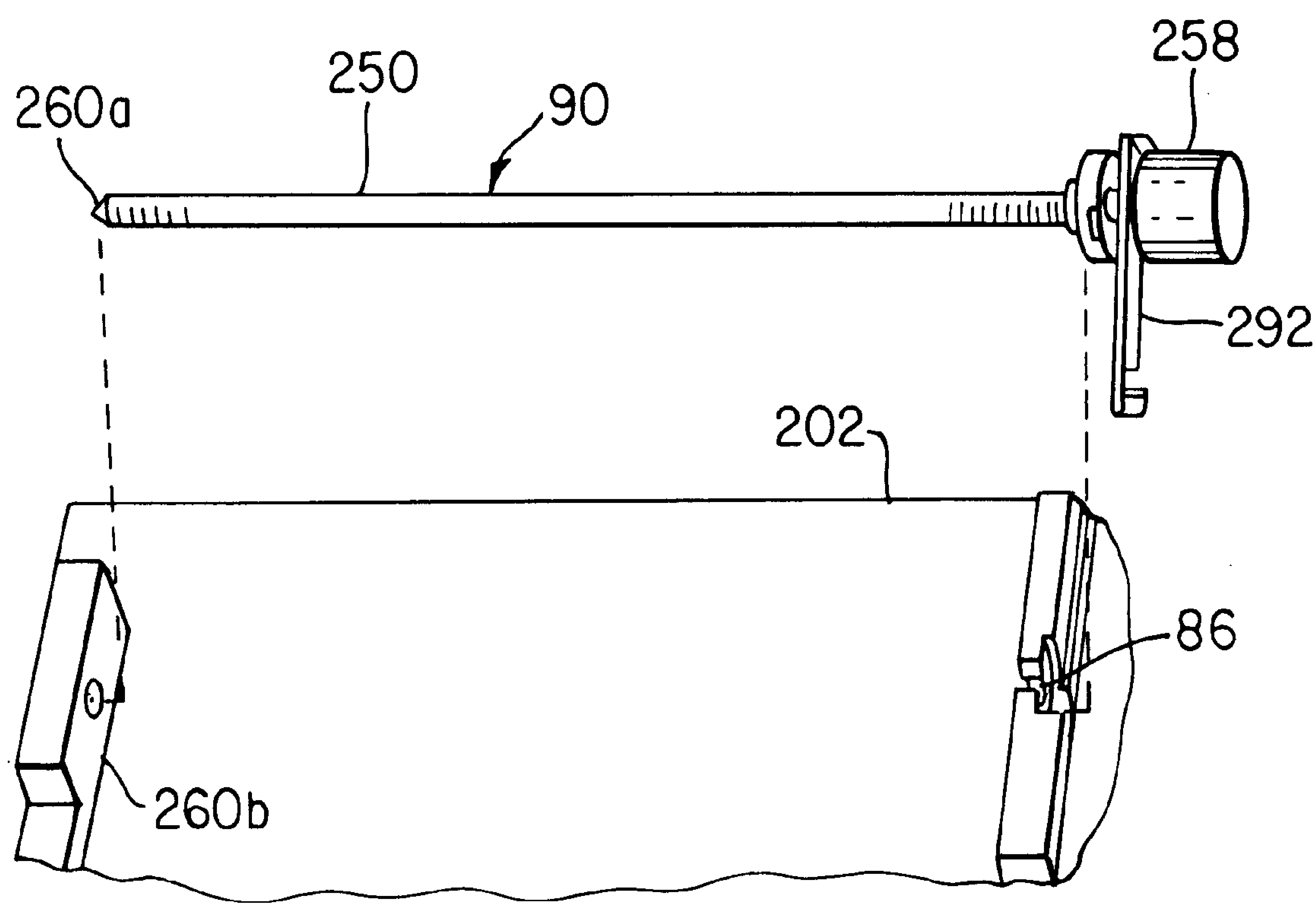
(57) **ABSTRACT**

An image processing apparatus (**10**) comprises an imaging drum (**300**) for holding print media (**32**) and donor material (**36**) in registration on the imaging drum (**300**). A print head (**500**), driven by a lead screw (**250**), moves along a line parallel to a longitudinal axis (X) of the imaging drum (**300**) as the imaging drum (**300**) rotates. A lead screw assembly (**90**) is secured in place in a scanning frame by magnetic attraction, with one magnet disposed to constrain axial motion by holding the lead screw to a fixed point and the other magnet disposed to secure the lead screw assembly (**90**) in place and allow rotational motion. Magnetic attraction allows the removal and replacement of the complete lead screw assembly (**90**) without tools.

10 Claims, 6 Drawing Sheets



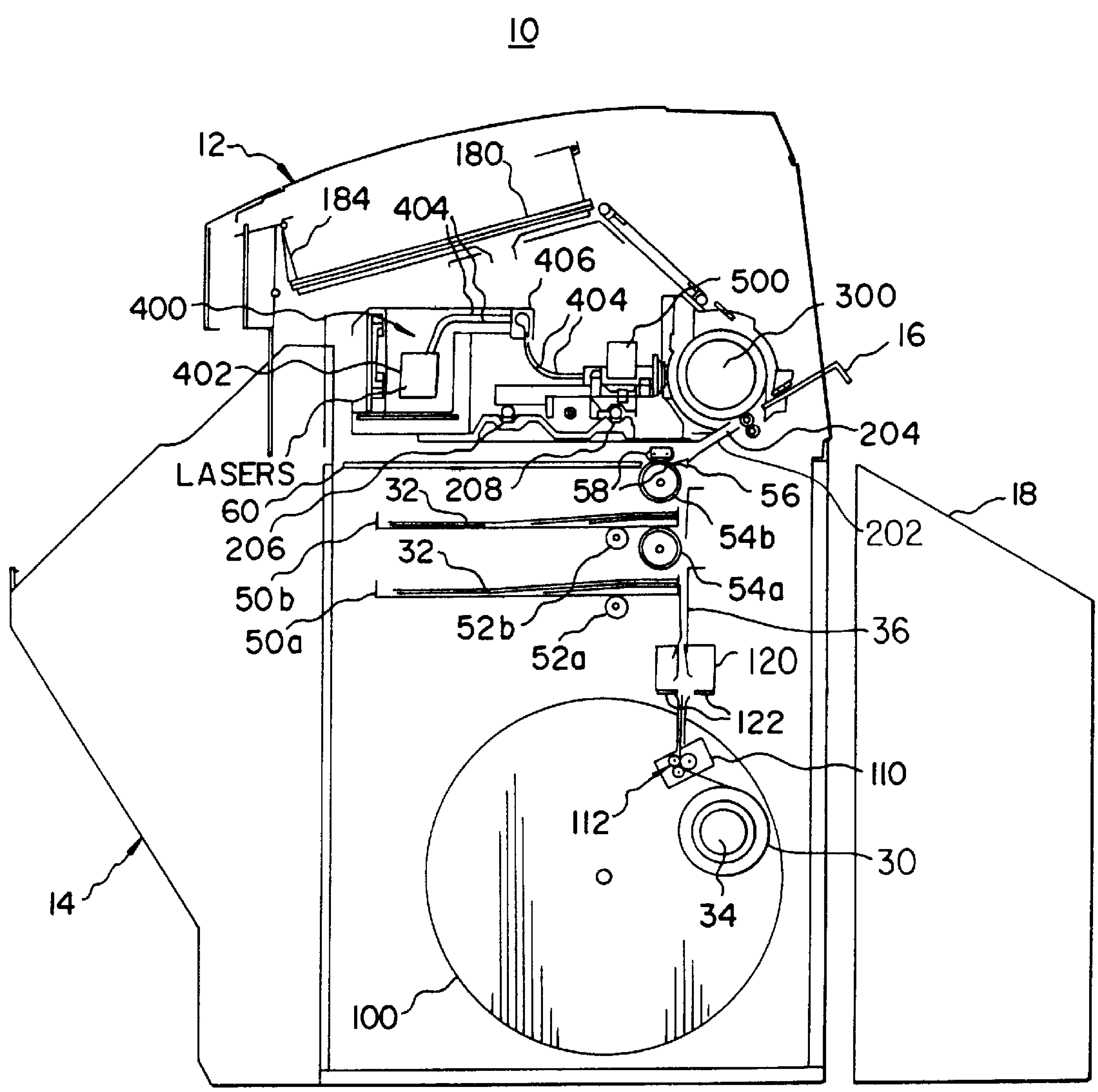

10
12
180
184
404
406
404
500
300
16
400
402
LASERS
60
206
208
58
56
204
202
18
32
32
54b
54a
50b
50a
52b
52a
36
120
122
110
112
30
34
14
100

FIG. 1

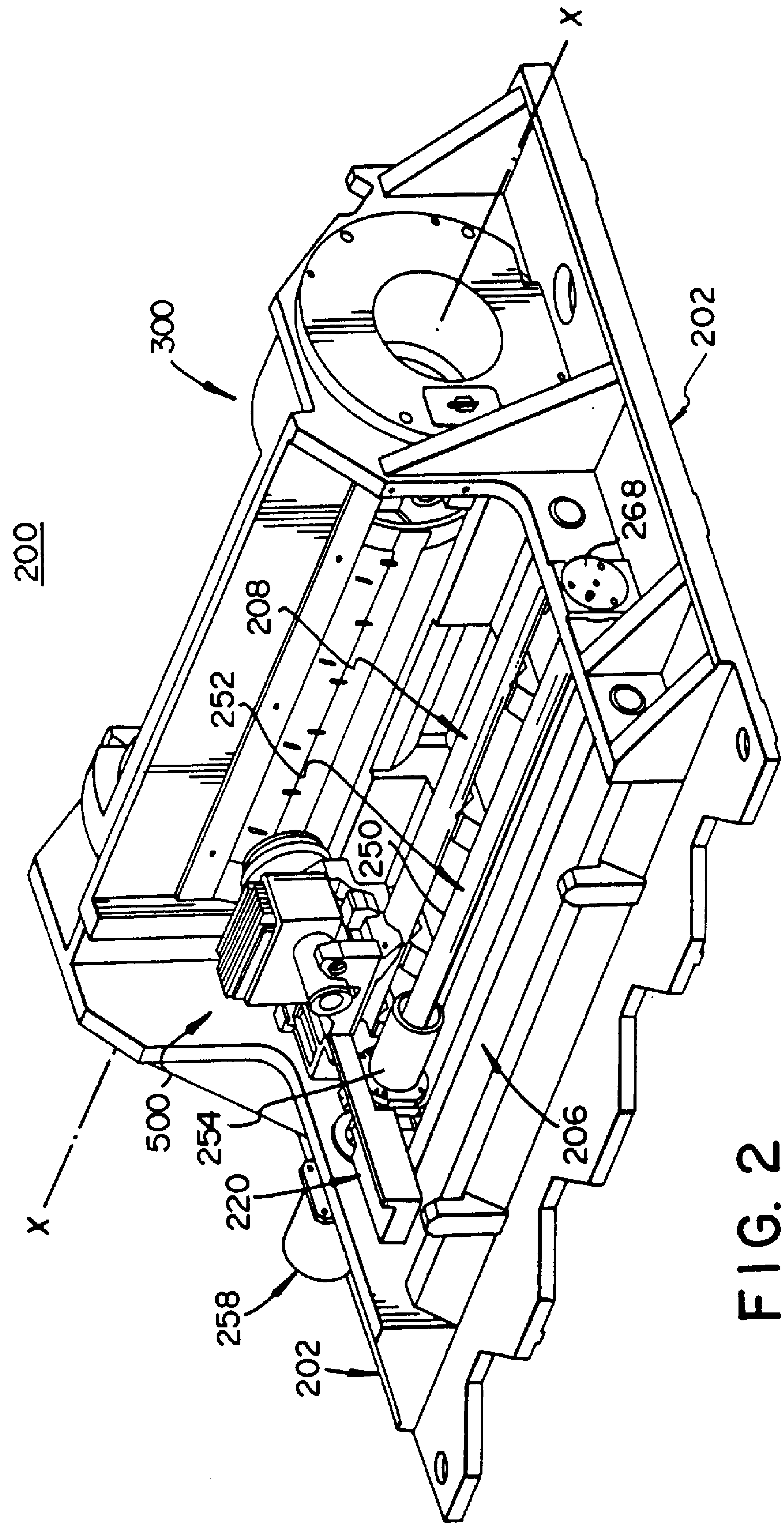


FIG. 2

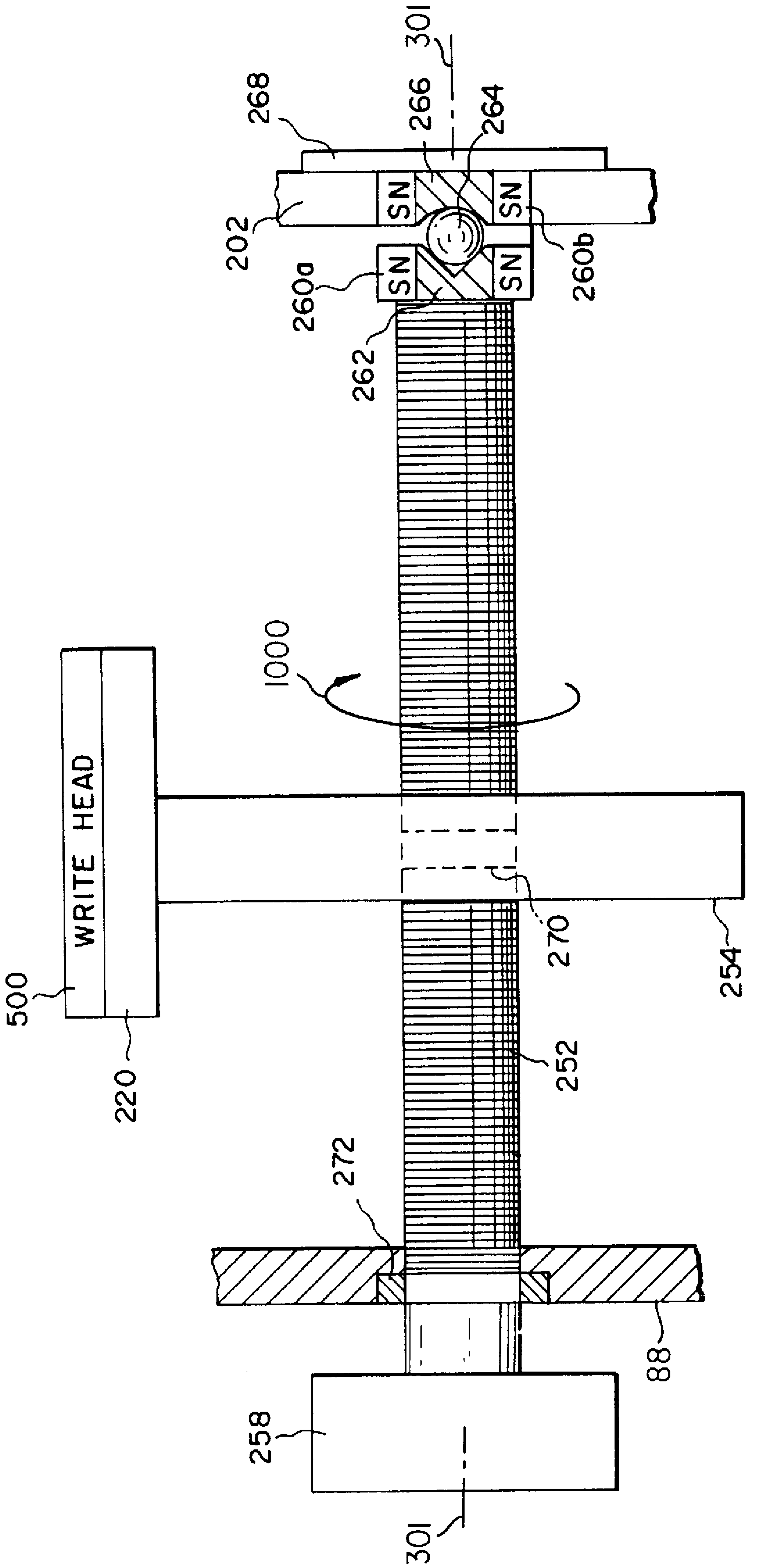

301
268
266
264
202
SN
SN
SN
SN
260a
260b
262
1000
WRITE HEAD
250
500
220
270
254
252
272
88
258
301

FIG. 3

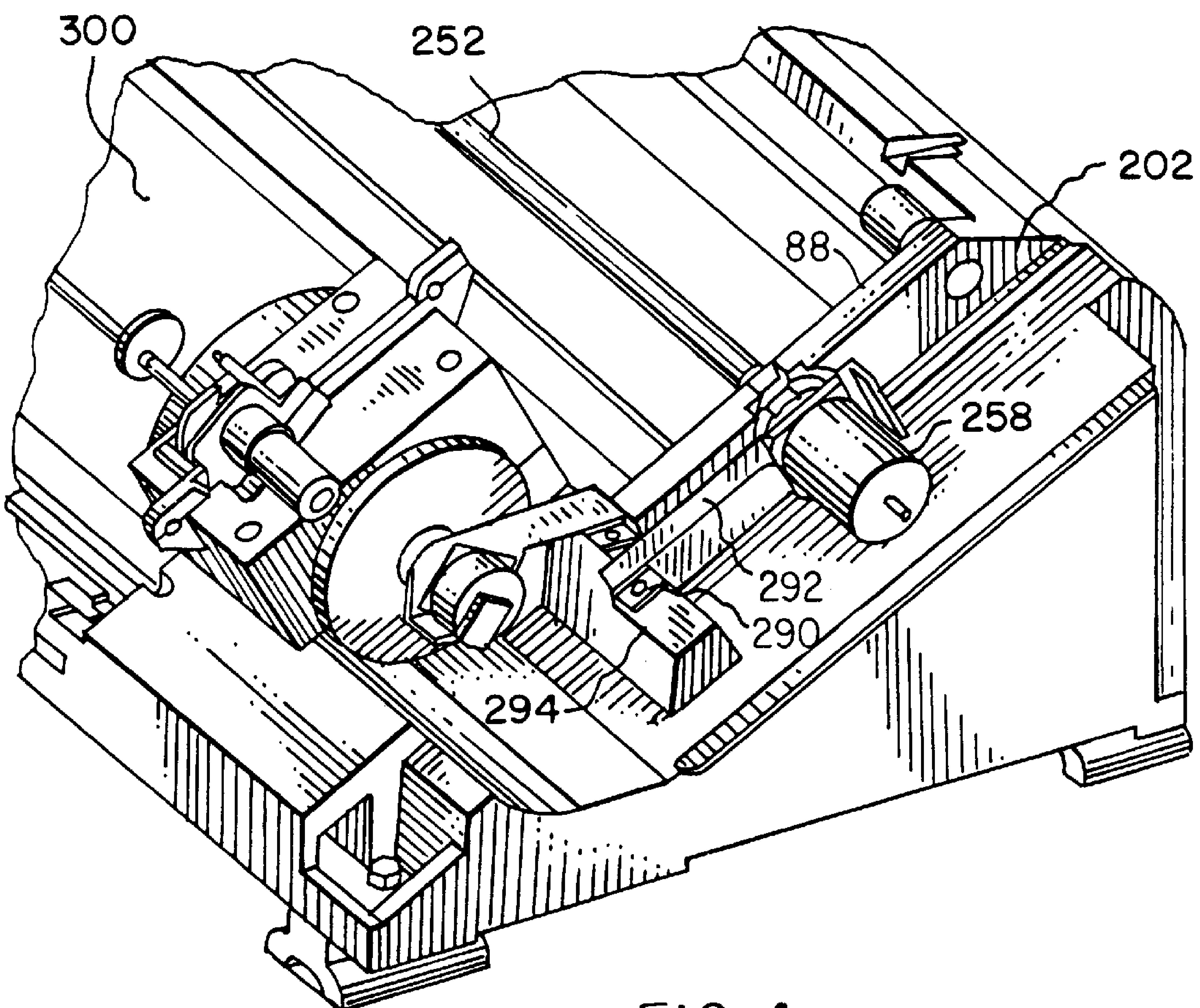


FIG. 4

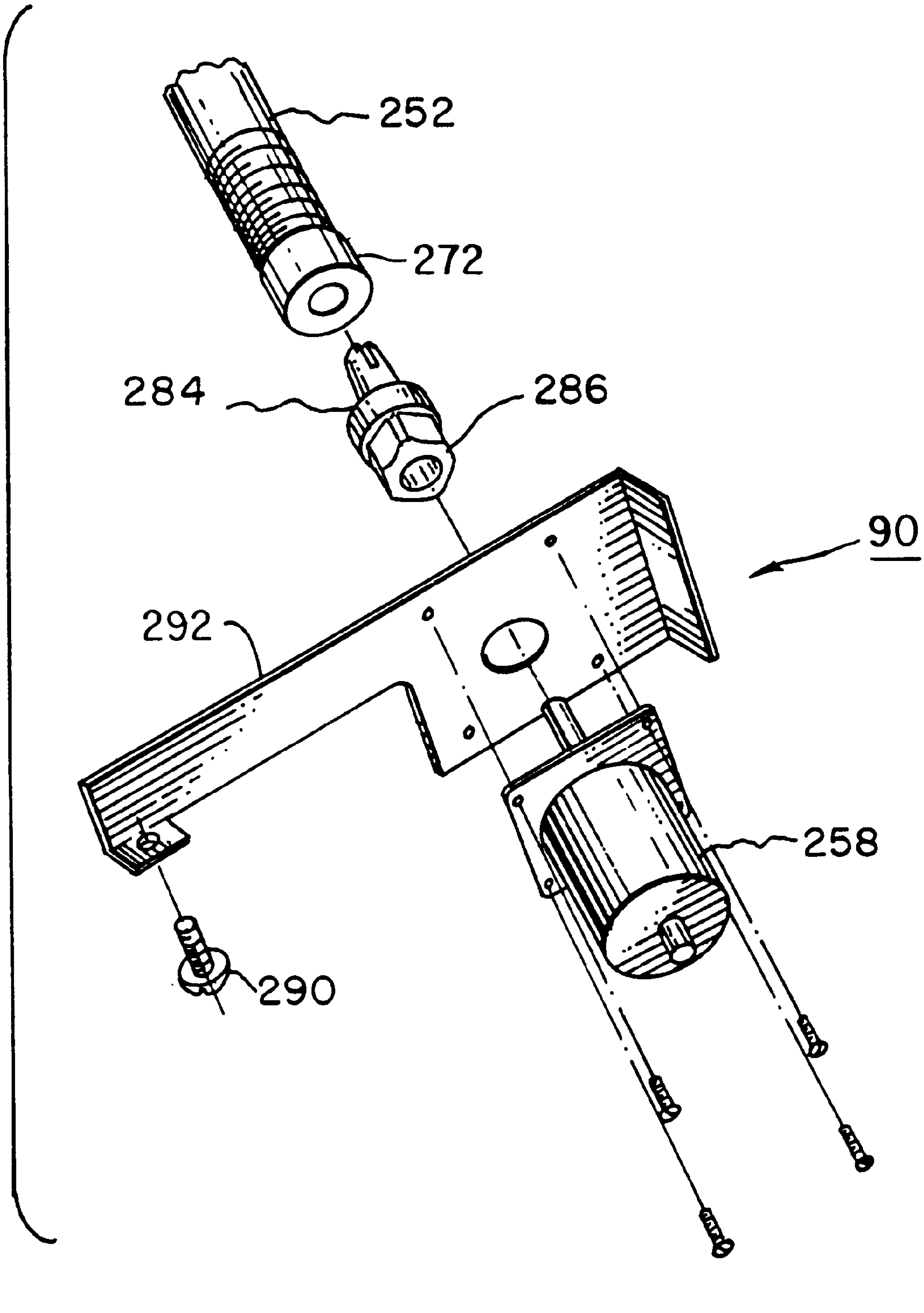


FIG. 5

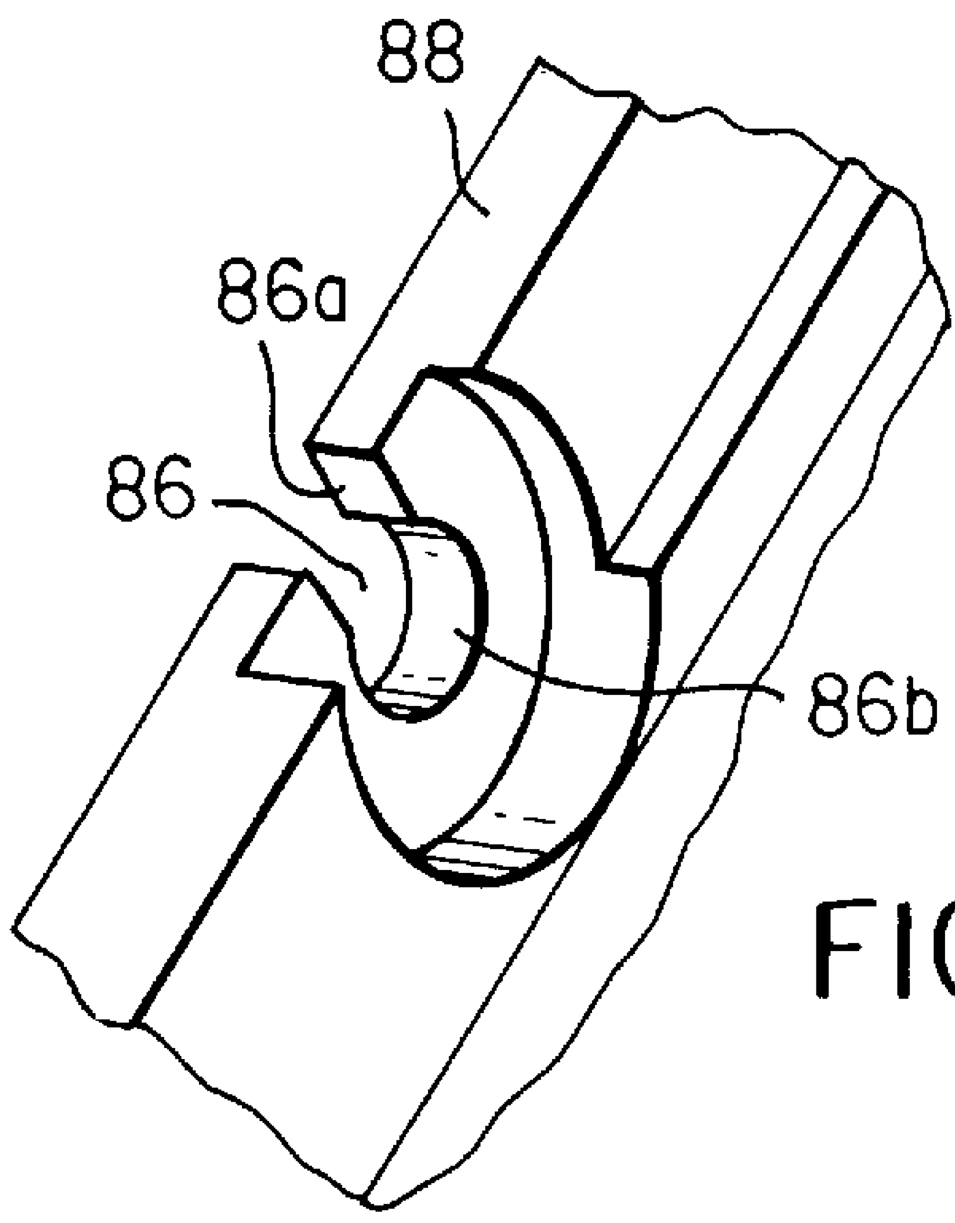


FIG. 6

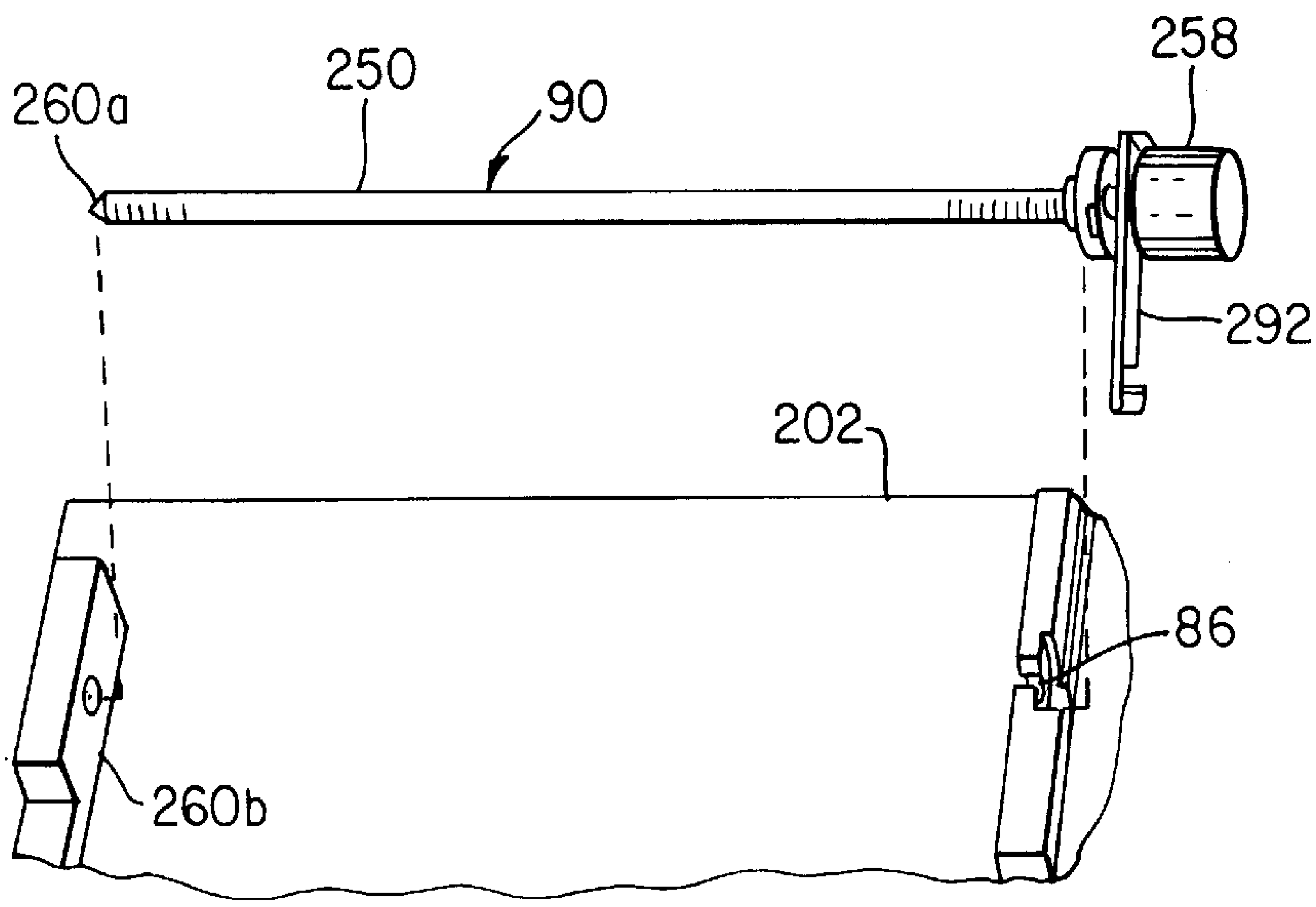


FIG 7a

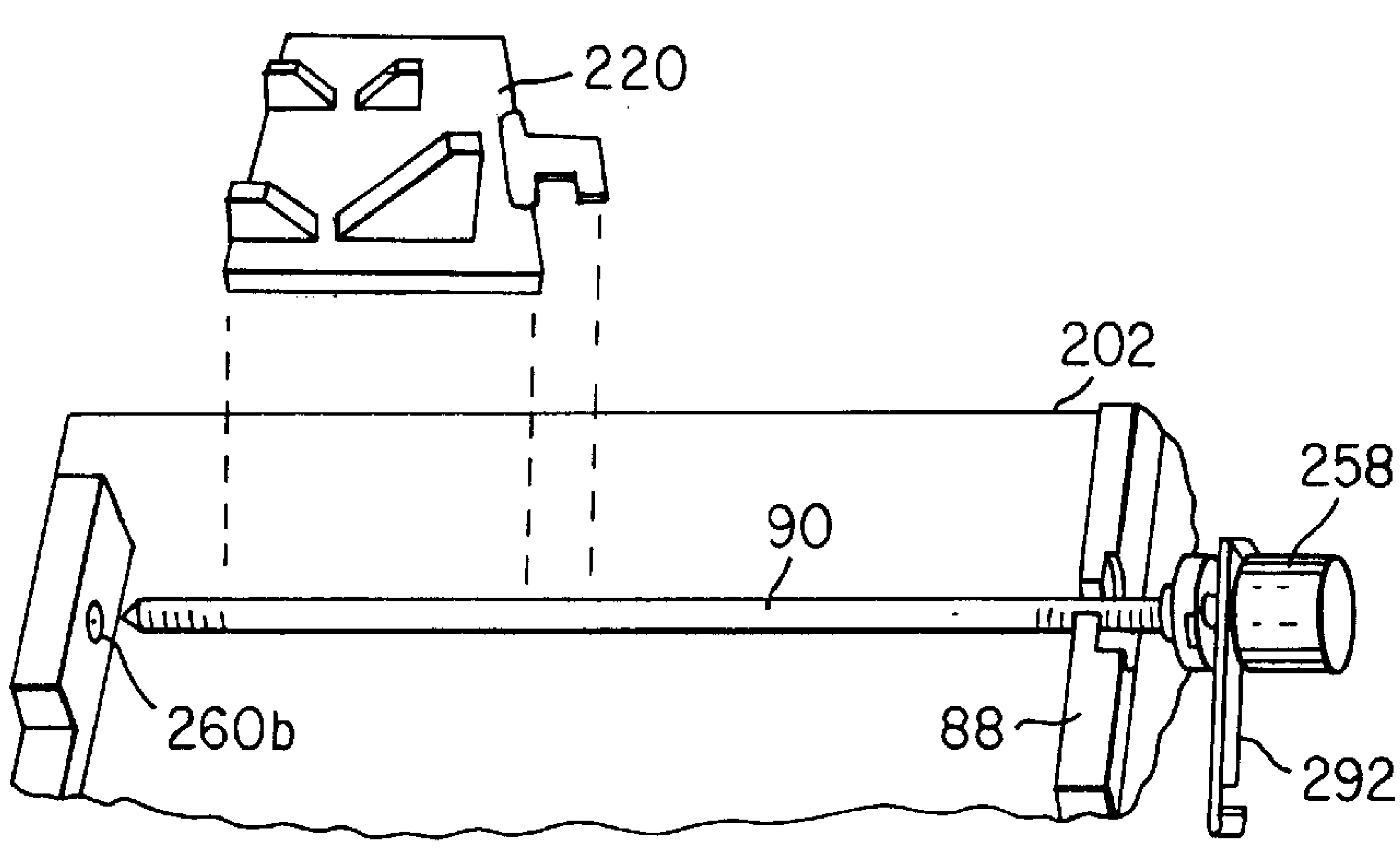


FIG. 7b

REMOVABLE LEAD SCREW ASSEMBLY FOR AN IMAGE PROCESSING APPARATUS

CROSS REFERENCE TO RELATED APPLICATIONS

The present invention is related to co-pending application Ser. No. 09/080,841 filed on May 18, 1998, entitled MAGNETICALLY HELD MOTOR STOP; co-pending application Ser. No. 09/144,390 filed on Aug. 31, 1998, entitled METHOD OF CONTROLLING A PRINTHEAD MOVEMENT BASED ON A SCREW PITCH TO MINIMIZE SWATH-TO-SWATH ERROR IN AN IMAGE PROCESSING APPARATUS; and co-pending application Ser. No. 08/795,171 filed on Feb. 4, 1997, entitled A METHOD AND APPARATUS FOR MAGNETICALLY PRELOADING A BALL BEARING ASSEMBLY.

FIELD OF THE INVENTION

This invention relates to the mechanical configuration of a lead screw and its stepper motor in an image processing apparatus.

BACKGROUND OF THE INVENTION

Pre-press color proofing is a procedure that is used by the printing industry for creating representative images of printed material, without the high cost and time that is required to actually produce printing plates and set up a high-speed, high-volume, printing press to produce a single example of an intended image. These intended images may require several corrections and may need to be reproduced several times to satisfy the requirements of customers, resulting in a large loss of profits. By utilizing pre-press color proofing, time and money can be saved.

One such commercially available image processing apparatus, which is depicted in U.S. Pat. No. 5,268,708, is an image processing apparatus having half-tone color proofing capabilities. This image processing apparatus is arranged to form an intended image on a sheet of thermal print media by transferring colorant from a sheet of donor material to thermal print media by applying a sufficient amount of thermal energy to the donor material to form an intended image. This image processing apparatus is comprised generally of a material supply assembly or carousel, a lathe bed scanning subsystem (which includes a lathe bed scanning frame, a translation drive, a translation stage member, a print-head, and a vacuum imaging drum), and thermal print media and donor material exit transports.

The operation of the image processing apparatus of U.S. Pat. No. 5,268,708 comprises metering a length of the thermal print media (in roll form) from the material assembly or carousel. The thermal print media is then measured and cut into sheet form of the required length, transported to the vacuum imaging drum, registered, wrapped around and secured onto the vacuum imaging drum. Next a length of donor material (in roll form) is also metered out of the material supply assembly or carousel, measured and cut into sheet form of the required length. It is then transported to and wrapped around the vacuum imaging drum, such that it is superposed in the desired registration with respect to the thermal print media (which has already been secured to the vacuum imaging drum).

After the donor material is secured to the periphery of the vacuum imaging drum, the scanning subsystem or write engine provides the scanning function. This is accomplished by retaining the thermal print media and the donor material on the spinning vacuum imaging drum while it is rotated past the print head that will expose the thermal print media. The translation drive then traverses the print head and translation stage member axially along the vacuum imaging drum, in coordinated motion with the rotating vacuum imaging drum. These movements combine to produce the intended image on the thermal print media.

The lathe bed scanning frame provides the structure to support the vacuum imaging drum and its rotational drive. The translation drive with the translation stage member and print head are supported by two translation bearing rods that are substantially straight along their longitudinal axis and are positioned parallel to the vacuum imaging drum and a lead screw. Consequently, they are parallel to each other therein forming a plane, along with the vacuum imaging drum and lead screw. The translation bearing rods are, in turn, supported by the outside walls of the lathe bed scanning frame of the lathe bed scanning subsystem or write engine. The translation bearing rods are positioned and aligned there between, for permitting low friction movement of the translation stage member and the translation drive. The translation bearing rods are sufficiently rigid for this application, so as not to sag or distort between the mounting points at their ends. They are arranged to be as exactly parallel as is possible with the axis of the vacuum imaging drum. The front translation bearing rod is arranged to locate the axis of the print head precisely on the axis of the vacuum imaging drum with the axis of the print head located perpendicular, vertical, and horizontal to the axis of the vacuum imaging drum. The translation stage member front bearing is arranged to form an inverted "V" and provides only that constraint to the translation stage member. The translation stage member with the print head mounted on the translation stage member, is held in place by its own weight. The rear translation bearing rod locates the translation stage member with respect to rotation of the translation stage member about the axis of the front translation bearing rod.

In U.S. Pat. No. 5,268,708, the translation stage member and print head are attached to a rotatable lead screw (having a threaded shaft) by a drive nut and coupling. The coupling is arranged to accommodate misalignment of the drive nut and lead screw so that only rotational forces and forces parallel to the lead screw are imparted to the translation stage member by the lead screw and drive nut. The lead screw rests between two sides of a lathe bed scanning frame of the lathe bed scanning subsystem or write engine, where it is supported by deep groove radial bearings. At the drive end the lead screw continues through the deep groove radial bearing, through a pair of spring retainers, that are separated and loaded by a compression spring to provide axial loading, and to a DC servo drive motor and encoder. The DC servo drive motor induces rotation to the lead screw moving the translation stage member and print head along the threaded shaft as the lead screw is rotated. The lateral directional movement of the print head is controlled by switching the direction of rotation of the DC servo drive motor and thus the lead screw.

Although the presently known and utilized image processing apparatus is satisfactory, it is not without drawbacks. In order to achieve the positioning accuracy for high-resolution imaging at 1800 dots per inch or greater, the apparatus described above utilizes a lead screw having a very fine thread pitch. Approaches to this problem disclosed in co-pending application Ser. No. 09/144,390 filed on Aug. 31, 1998 allow a coarser lead screw pitch to be used.

It can be appreciated that a significant amount of design work is required to maintain synchronization and dot addressability in an imaging apparatus where a print head, possibly having a variable number of light sources, is moving linearly along a high-speed rotating imaging drum. To achieve the necessary timing for this imaging task, a specific lead screw thread pitch is selected for the imaging resolution that is required. Co-pending application Ser. No. 09/144,390 filed on Aug. 31, 1998 discloses a method and example for calculating lead screw pitch for an apparatus imaging at 2540 dots per inch.

It would be advantageous to be able to readily change the resolution of an imaging apparatus to suit different requirements of end-customers who use such equipment. For example, there are significant advantages for an image processing apparatus that could operate at both 2540 dots per inch and at 2400 dots per inch. A preferred solution for meeting this requirement is to enable each resolution using a different lead screw pitch.

It will be appreciated that changing the lead screw in a high-resolution imaging apparatus presents considerable problems. Conventional solutions would require a significant amount of disassembly to loosen the lead screw from mounting, fastening, and support hardware at each end and to install the alternate lead screw in its place. Service costs for lead screw replacement at an end-customer site would limit the market value of such a solution. End-customers would be likely to reject conventional solutions for lead screw replacement as troublesome, costly, time-consuming, and error-prone.

Lead screw replacement conventionally requires tools and involves well-trained personnel to make necessary adjustments so that synchronization timing can be maintained. Patents that disclose methods for lead screw replacement include U.S. Pat. No. 4,628,171, which discloses a mechanical-feed boring machine tool with interchangeable lead screws, where different lead screw pitches are needed to change the threading pitch achieved by this machine. Conventional hand tools and detailed disassembly procedures are required to substitute another lead screw having a different thread pitch with this approach.

The apparatus disclosed in U.S. Pat. No. 5,771,059 employs a magnet integrally attached to the lead screw that allows one end of the lead screw to be removed from its position in the scanning frame. Also, the apparatus disclosed in co-pending application Ser. No. 08/795,171 uses a magnetically loaded radial bearing integrated with the lead screw shaft that allows the opposite end of the lead screw to be securely held in position within a frame, while at the same time providing a bearing to allow rotational movement. However, none of the arrangements noted above show or suggest a structure or method which permits the removal and the re-seating of a complete lead-screw assembly without requiring tools.

SUMMARY OF THE INVENTION

The present invention provides for an apparatus which overcomes the drawbacks noted above. Briefly summarized, according to one aspect of the present invention, the invention resides in an imaging processing apparatus of the lathe-bed scanning type, where a print head is secured to a translation stage member. A lead screw provides linear movement of the translation stage member. The assembly comprises the lead screw and its attached motor and support hardware which form a removable, modular assembly that is held in place by magnetic attraction, and can be removed from and re-seated in a scanning frame without tools.

An object of the present invention is to provide for a lead screw assembly that installs in the scanning frame as a single unit and is self-seating, fitting into place and secured in the proper position without mechanical fasteners.

It is an advantage of the present invention that it enables an image processing apparatus to be operable with any one of a set of lead screws, where each lead screw can have a different thread pitch or other characteristics.

It is a further advantage of the present invention that it allows installation or removal of a lead screw assembly in an image processing apparatus without tools and without mechanical adjustments for precision alignment.

It is noted that the present invention could be used in other applications, including imaging applications that are not limited to imaging using dye transfer. It is recognized that the present invention is pertinent to various types of laser, heat, or radiation-induced transfer involving colorants such as inks, dyes, or pigments. The present invention could also be employed in other types of devices where it is useful to be able to remove a lead screw and its associated components without tools.

The present invention relates to a writing assembly having a removable self-seating lead screw. The writing assembly comprises a supporting frame; a lead screw which defines a linear direction of movement for a writing element; and an attraction assembly for permitting an insertion of the lead screw to an operating position on the supporting frame. The lead screw is held in the operating position while being permitted to rotate about a longitudinal axis of the lead screw. The attraction assembly permits a manual removal of the lead screw from the operating position on the supporting frame.

The present invention further relates to a writing assembly having a removable lead screw which comprises a frame member for supporting the lead screw; first attraction means attached to a first end of the lead screw; second attraction means on the frame member for attracting the first attraction means to removably hold the first end of the lead screw on the frame member when the lead screw is in an operating position on the frame member; a magnetically loaded radial bearing mounted on a second end of the lead screw which permits a rotation of the lead screw when the lead screw is in the operating position; and a receiving means on the frame member for removably holding the radial bearing therein when the lead screw is in the operating position, the lead screw being manually removable at the first and second ends from the frame member.

The present invention further relates to a lead screw assembly for an image capture device which comprises a lead screw which defines a linear direction of movement for a writing element; a first attraction member on a first end of the lead screw which cooperates with a second attraction member on a frame of the image capture device to rotatably and removably hold the first end of the lead screw on the frame; and a bearing member provided on a second end of the lead screw which cooperates with a receiving member on the frame to rotatably and removably hold the second end of the lead screw on the frame.

The present invention further relates to a method of removably mounting a lead screw assembly of an image capture device. The method comprises the steps of: providing a first attraction member on a first end of a lead screw, with the lead screw defining a linear direction of movement for a writing assembly of the image capture device; providing a bearing member on a second end of the lead screw; and attaching the lead screw to a frame member of the image capture device. The first attraction member cooperates with a second attraction member on the frame and the bearing member cooperates with a receiving member on the frame to removably hold the lead screw to the frame at the first and second ends.

The present invention further relates to an image processing apparatus which comprises a writing assembly mounted on a supporting member so as to be adjacent to an imaging member; a removable lead screw assembly which provides a linear movement to the writing assembly relative to the imaging member, with the lead screw assembly comprising a lead screw and a drive motor which rotates the lead screw; and an attraction assembly which holds the lead screw assembly in an operating position on the support member in a manner which permits a removal of the lead screw assembly as a unit from the operating position on said supporting member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view in vertical cross section of an image processing apparatus of the present invention;

FIG. **2** is a perspective view of a lathe-bed scanning subsystem or write engine of the present invention, as viewed from the rear of the image processing apparatus;

FIG. **3** is a top view in horizontal cross-section, partially in phantom, of the lead screw of the present invention;

FIG. **4** is a perspective view showing components on a motordriven side of the lead screw in a preferred embodiment of the present invention;

FIG. **5** shows an exploded view of the assembly of components on the motor-driven side of the lead screw in the embodiment shown in FIG. **4**;

FIG. **6** shows an opening provided in a side panel of a scanning frame for placement of the lead screw assembly; and

FIGS. **7***a* and **7***b* illustrate an exploded view showing the lead screw assembly as it is installed or removed, relative to the print head and to the main chassis of the lathe-bed scanning subsystem.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, wherein the like reference numerals represent identical or corresponding parts throughout the several views, FIG. **1** illustrates an example of an image processing apparatus **10** relevant to the present invention. Image processing apparatus **10** includes an image processor housing **12** which provides a protective cover. A movable, hinged image processor door **14** is attached to a front portion of image processor housing **12** permitting access to sheet material trays, such as lower sheet material tray **50***a* and upper sheet material tray **50***b*, that are positioned in an interior portion of image processor housing **12**, for supporting print media **32** thereon. Only one of sheet material trays **50***a*, **50***b* will dispense print media **32** out of its sheet material tray to create an intended image thereon; the alternate sheet material tray **50***a*, **50***b* either holds an alternative type of print media **32** or functions as a back up sheet material tray. In this regard, lower sheet material tray **50***a* includes lower media lift cam **52***a* for lifting lower sheet material tray **50***a* and ultimately print media **32**, upwardly toward rotatable, lower media roller **54***a* and toward a second rotatable, upper media roller **54***b* which, when both are rotated, permit print media **32** to be pulled upwardly towards a movable media guide **56**. Upper sheet material tray **50***b* includes upper media lift cam **52***b* for lifting upper sheet material tray **50***b* and ultimately print media **32** towards upper media roller **54***b* which directs it towards media guide **56**.

Media guide **56** directs print media **32** under a pair of media guide rollers **58** which engage print media **32** for assisting upper media roller **54***b* in directing it onto a media staging tray **60**. Media guide **56** is attached and hinged to a lathe bed scanning frame **202** at one end, and is uninhibited at its other end for permitting multiple positioning of media guide **56**. Media guide **56** then rotates its uninhibited end downwardly, as illustrated in the position shown, and the direction of rotation of upper media roller **54***b* is reversed for moving print media **32** resting on media staging tray **60** under the pair of media guide rollers **58**, upwardly through an entrance passageway **204** and around a rotatable vacuum imaging drum **300**.

A roll **30** of colorant donor roll material **34** is connected to a media carousel **100** in a lower portion of image processor housing **12**. Four rolls of roll media **30** are used, but only one is shown for clarity. Each roll media **30** includes a donor roll material **34** of a different color, typically black, yellow, magenta and cyan. These donor roll materials **34** are ultimately cut into donor sheet materials **36** and passed to vacuum imaging drum **300** for forming the medium from which colorant imbedded therein is passed to print media **32** resting thereon. In this regard, a media drive mechanism **110** is attached to each roll **30** of donor roll material **34**, and includes three media drive rollers **112** through which the donor roll material **34** of interest is metered upwardly into media knife assembly **120**. After the donor roll material **34** reaches a predetermined position, media drive rollers **112** cease driving the donor roll material **34** and two media knife blades **122** positioned at a bottom portion of media knife assembly **120** cut the donor roll material **34** into donor materials **36**. Lower media roller **54***a* and upper media roller **54***b* along with media guide **56** then pass a donor sheet material **36** onto media staging tray **60** and ultimately to vacuum imaging drum **300**; and in registration with print media **32** using the same process as described above for passing print media **32** onto vacuum imaging drum **300**. The donor sheet material **36** now rests atop print media **32** with a narrow space between the two created by microbeads imbedded in the surface of print media **32**.

A laser assembly **400** includes a quantity of laser diodes **402** in its interior. Lasers diodes **402** are connected via fiber optic cables **404** to distribution block **406** and ultimately to a print head **500**. Print head **500** directs energy received from laser diodes **402** causing the donor sheet material **36** to pass the desired color across the gap to print media **32**. Print head **500** is attached to a lead screw **250** (FIG. **2**) via a lead screw drive nut **254** and drive coupling (not shown), for permitting movement axially along a longitudinal axis of vacuum imaging drum **300** for transferring the data to create the intended image onto print media **32**.

For writing, vacuum imaging drum **300** rotates at a constant velocity, and print head **500** begins at one end of print media **32** and traverses the entire length of the print media **32** for completing the transfer process for the particular donor sheet material **36** resting on print media **32**. After print head **500** has completed the transfer process, for the particular donor sheet material **36** resting on print media **32**, the donor sheet material **36** is then removed from vacuum imaging drum **300** and transferred out of image processor housing **12** via a skive or ejection chute **16**. Donor sheet material **36** eventually comes to rest in a waste bin **18** for removal by the user. The above described process is then repeated for the other three rolls of roll media **30** of donor roll materials **34**.

Referring to FIG. **2**, there is illustrated a perspective view of a lathe bed scanning subsystem **200** of image processing apparatus **10**, including vacuum imaging drum **300**, print head **500** and lead screw **250** assembled in lathe bed scanning frame **202**. Vacuum imaging drum **300** is mounted for rotation about an axis X in lathe bed scanning frame **202**. Print head **500** is movable with respect to vacuum imaging drum **300**, and is arranged to direct a beam of light to donor sheet material **36**. As an example, the beam of light from print head **500** for each laser diode **402** (not shown in FIG. **2**) can be individually modulated by modulated electronic signals from image processing apparatus **10**, which are representative of the shape and color of the original image; so that the color on the donor sheet material **36** is heated to cause volatilization only in those areas in which its presence is required on the print media **32** to reconstruct the shape and color of the original image.

Print head **500** is mounted on movable translation stage member **220** which, in turn, is supported for low friction slidable movement on translation bearing rods **206** and **208**. Translation bearing rods **206** and **208** are arranged as parallel as possible with axis X of vacuum imaging drum **300**. A longitudinal axis of print head **500** is perpendicular to the axis X of vacuum imaging drum **300**. Front translation bearing rod **208** locates translation stage member **220** in vertical and horizontal directions with respect to axis X of vacuum imaging drum **300**. Rear translation bearing rod **206** locates translation stage member **220** with respect to rotation of translation stage member **220** about front translation bearing rod **208**, so that there is no over-constraint condition of translation stage member **220** which might cause it to bind, chatter, or otherwise impart undesirable vibration or jitters to print head **500** during the generation of an intended image.

As shown in FIG. **3**, lead screw **250** is attached to a linear drive motor **258** on its drive end and to lathe bed scanning frame **202** by means of radial bearing **272**. Lead screw drive nut **254** includes grooves in its hollowed-out center portion **270** for mating with threads of threaded shaft **252** of lead screw **250**, for permitting lead screw drive nut **254** to move axially along threaded shaft **252** as threaded shaft **252** is rotated by linear drive motor **258**. Lead screw drive nut **254** is integrally attached to print head **500** through a lead screw coupling and translation stage member **220** at its periphery so that as threaded shaft **252** is rotated by linear drive motor **258**, lead screw drive nut **254** moves axially along threaded shaft **252**, which in turn moves translation stage member **220** and ultimately print head **500** axially along vacuum imaging drum **300**.

As best illustrated in FIG. **3**, and as described in U.S. Pat. No. 5,771,059, an annular-shaped axial load magnet **260***a* is integrally attached to a driven end of threaded shaft **252**, and is in a spaced apart relationship with another annular-shaped axial load magnet **260***b* attached to lathe bed scanning frame **202**. Axial load magnets **260***a* and **260***b* are preferably made of rare-earth materials such as neodymium-iron-boron. A generally circular-shaped boss part **262** of threaded shaft **252** rests in a hollowed-out portion of annular-shaped axial load magnet **260***a*, and includes a generally V-shaped surface at the end for receiving a ball bearing **264**. A circular-shaped insert **266** is placed in a hollowed-out portion of the other annular-shaped axial load magnet **260***b*, and includes a shaped surface on one end for receiving ball bearing **264**, and a flat surface at its other end for receiving end cap **268**. End cap **268** is placed over annular-shaped axial load magnet **260***b* and attached to lathe bed scanning frame **202** for protectively covering annular-shaped axial load magnet **260***b* and providing an axial stop for lead screw **250**. Circular shaped insert **266** is preferably made of material such as Rulon J or Delrin AF, both well known in the art.

Lead screw **250** operates as follows. Linear drive motor **258** is energized and imparts rotation to lead screw **250** about axis **301**, as indicated by the arrow **1000**, causing lead screw drive nut **254** to move axially along threaded shaft **252**. Annular-shaped axial load magnets **260***a* and **260***b* are magnetically attracted to each other which prevents axial movement of lead screw **250**. Ball bearing **264**, however, permits rotation of lead screw **250** while maintaining the positional relationship of annular-shaped axial load magnets **260***a*, **260***b*, i.e., slightly spaced apart, which prevents mechanical friction between them while obviously permitting threaded shaft **252** to rotate.

Print head **500** travels in a path along vacuum imaging drum **300**, while being moved at a speed synchronous with the rotation of vacuum imaging drum **300** and proportional to a width of a writing swath. The pattern that print head **500** transfers to print media **32** along vacuum imaging drum **300** is a helix.

FIGS. **4** and **5** show components at the drive end of lead screw **250**. Radial bearing **272** which is a magnetically loaded radial bearing is mounted on threaded shaft **252** (FIG. **5**). Linear drive motor **258** is a stepper motor in the preferred embodiment of this invention. As shown in FIG. **5**, a shaft **258***a* of linear drive motor **258** attaches to threaded shaft **252** of lead screw **250** by means of a collet **284**, secured by a nut collet **286**. Motor **258** mounts to a rotational motor stop or frame **292**, which provides a rotational stop that constrains movement of motor **258** as its shaft rotates. A stop button **290** attached to rotational motor stop **292** is magnetically attracted to a stop magnet **294** which is installed inside lathe bed scanning frame **202** (at the position shown in FIG. **4**).

The components illustrated in FIG.**5** make up a lead screw assembly **90**. Lead screw assembly **90** is removable as a unit from its position in lathe bed scanning frame **202**.

FIG. **6** shows an aperture **86** in a motor support member **88** of lathe bed scanning frame **202**, with lead screw assembly **90** removed. In an operating position, the motor end (with motor **258**) of lead screw assembly **90** is held in place in motor support member **88** by magnetization of radial bearing **272**. The opposite end of lead screw assembly **90** is held in place by attraction of axial load magnets **260***a* and **260***b* as shown in FIG. **3**. With this arrangement, magnetic attraction at both ends fixes the axis of threaded shaft **252** into position with respect to lathe bed scanning frame **202**. Then, to prevent rotation of lead screw assembly **90** as threaded shaft **252** rotates, rotational motor stop **292** is provided, and held in position by magnetic attraction at stop button **290**.

An access slot **86***a* of aperture **86** is sized to be slightly larger than a diameter of threaded shaft **252**, to permit the removal of lead screw assembly **90** only after the opposite end of lead screw assembly **90** is pulled away a slight distance from axial load magnets **260***a* and **260***b*, so that radial bearing **272** and other components on the motor end of lead screw assembly **90** can clear the access slot. A circular inner portion **86***b* of aperture **86** is sized so that radial bearing **272** fits snugly into motor support member **88**, held by magnetic attraction of radial bearing **272** to motor support member **88**. Attraction of axial load magnets **260***a* and **260***b* at the opposite end of threaded shaft **252** hold lead screw assembly **90** at the correct position so that lead screw assembly **90** can be removed and re-seated in the same position each time.

FIGS. 7*a* and 7*b* show how lead screw **250** or lead screw assembly **90** including lead screw **250** are removed from lathe bed scanning frame **202**. First, translation stage member **220** and print head **500** (not shown in FIGS. 7*a* and 7*b*) must be disconnected from lead screw **250**. In the preferred embodiment of this invention, two screws (not shown) must be removed to unfasten translation stage member **220** from lead screw **250**. In the preferred embodiment of this invention, a modular electrical connector (not shown) must also be disconnected from linear drive motor **258**.

To free lead screw **250** or lead screw assembly **90** including lead screw **250** from its magnetic attraction points, rotational motor stop **292** is first pivoted up from attraction at stop magnet **294**. Next, lead screw **250** or lead screw assembly **90** including lead screw **250** are pulled away from axial load magnet **260***b*. Lead screw **250** or lead screw assembly **90** including lead screw **250** can then be pulled out horizontally from its normal operating position (to the right, as viewed in FIG. 7*a*), so that the diameter of threaded shaft **252** clears access slot **86***a* in aperture **86**, allowing removal of lead screw assembly **90**.

Insertion of an alternate lead screw **250** or lead screw assembly **90** including lead screw **250** is the reversal of the above procedure. Once lead screw **250** is fed through access slot **86***a* in aperture **86**, axial load magnets **260***a* and **260***b* attract the end of lead screw assembly **90** against lathe bed scanning frame **202**. Then, rotational motor stop **292** is pivoted into place, and held securely at stop magnet **294**. Finally, any needed electrical connections can be made to linear drive motor **258** and translation stage member **220** can be reinstalled.

The invention has been described with reference to the preferred embodiment thereof. However, it will be appreciated and understood that variations and modifications can be effected within the spirit and scope of the invention as described herein above and as defined in the appended claims, by a person of ordinary skill in the art without departing from the scope of the invention. For example, the overall configuration and arrangement of the slot and circular inner portion for the aperture can be altered without changing the scope of the invention.

What is claimed is:

1. A scanning assembly having a removable lead screw, the scanning assembly comprising:

attraction means on said frame member fir attracting said first attraction means to removably hold said first end of said lead screw on said frame member when said lead screw is in an operating position on said frame member;

a magnetically loaded radial bearing mounted on a second end of said lead screw which permits a rotation of said lead screw when said lead screw is in said operating position;

a receiving means on said frame member for removably holding said radial bearing therein when said lead screw is in said operating position, said lead screw being manually removable at said first and second ends from said frame member;

a drive motor operationally associated with said second end of said lead screw for rotating said lead screw; and

a rotational stop mounted to said second end of said lead screw to prevent rotation of at least said drive motor as said lead screw rotates.

2. A scanner assembly according to claim **1**, wherein one of said first and second attraction means is a magnet and the other of said first and second attraction means is a ferromagnetic member.

3. A removable lead screw assembly for an image capture device, the lead screw assembly comprising:

a lead screw which defines a linear direction of movement for a writing element;

a first attraction member on a first end of said lead screw which cooperates with a second attraction member on a frame of said image capture device to rotatably and removably hold said first end of said lead screw on said frame;

a bearing member provided on a second end of said lead screw which cooperates with a receiving member on said frame to rotatably and removably hold said second end of said lead screw on said frame;

a drive motor operationally associated with said second end of said lead screw for rotating said lead screw about a longitudinal axis of said lead screw; and

a rotational stop mounted to said second end of said lead screw to prevent rotation of said motor as said lead screw rotates.

4. A removable lead screw assembly according to claim **3**, wherein one of said first attraction member and said second attraction member is a magnet and the other of said first attraction member and said second attraction member is a ferromagnetic member.

5. A removable lead screw assembly according to claim **3**, wherein said bearing member is a magnetically loaded radial bearing.

6. A removable lead screw assembly according to claim **3**, wherein said writing element is a print head of said image capture device.

7. A method of removably mounting a lead screw assembly of an image capture device, the method comprising the steps of:

providing a first attraction member on a first end of a lead screw, said lead screw defining a linear direction of movement for a writing assembly of said image capture device;

providing a bearing member on a second end of said lead screw;

attaching said lead screw to a frame member of said image capture device, such that said first attraction member cooperates with a second attraction member on said frame and said bearing member cooperates with a receiving member on said frame to removably hold said lead screw to said frame at said first and second ends;

mounting a drive motor on said second end of said lead screw, said drive motor rotating said lead screw as said lead screw is removably held at said first and second ends to impart a linear motion to said writing assembly along said linear direction of movement; and

mounting a rotational stop on said second end of said lead screw to prevent rotation of at least said drive motor as said lead screw rotates.

8. A method according to claim **7**, wherein said first attraction member is one of a magnetic member or a ferromagnetic member, and said second attraction member is the other of said magnetic member or said ferromagnetic member.

9. A method according to claim **7**, wherein said bearing member is a magnetically loaded radial bearing and said receiving member defines a slot into which said radial bearing is inserted.

10. A method according to claim **7**, comprising the further steps of:

removing said lead screw from the frame member by pulling up on said first end of said lead screw so as to space the first and second attraction members from each other and moving the second end of said lead screw so as to withdraw the bearing member from said receiving member; and

replacing said removed lead screw with a further lead screw.

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